STROMBERG CARBURETORS-OVERVIEW

MYSTERIES OF THE STROMBERG CARBURETOR

By Doug Combs, for the Luscombe Endowment

The Stromberg Carburetor is often maligned, and sometimes questioned as 'inadequate' because it lacks an idle cut-off mixture control for engine shutdown, unlike most carburetors employed in aircraft. Because it was designed to be simple, and 'automatic', for use on primary small aircraft having low compression and very little "run-on"[1] tendency, it is somewhat unconventional. The Idle cut-off mixture feature was deemed to be un-necessary, and overly complex, so it was omitted in the design, favoring instead a leaning system referenced as a 'back-suction' mixture control used for high altitude leaning[2].

Aircraft Carburetor basics

ALL carburetors use two to four fuel circuits, or delivery methods to the engine. They are generally described as the Idle circuit, Mid range circuit, Accelerator circuit, and the Main jet circuit.

The Idle fuel circuit is simply a small hole at or near the throttle plate area that is regulated with a large brass needle valve adjusted from the outside of the throttle body. When the throttle is very nearly closed, the rapid movement of air past a small hole siphons fuel into the induction air stream (figure 3, item #2).

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[1] Run-on is a non technical term for an engine that continues to fire the cylinder after ignition is removed from the spark plug. This is sometimes referred to as "dieseling". The irregular firing is caused by a high compression ignition of the fuel-air mixture, sometimes by carbon embers in the cylinder, or another heated imperfection within the compression chamber of the cylinder.

[2] The back suction mixture is generally pretty automatic at all altitudes less than 7-8,000 feet IF the float level is accurately set on the bench. This means that manual manipulation of the mixture control should NOT be required until the aircraft is well above that altitude. When very high, the mixture manipulation should only be undertaken very judiciously, and only when monitored by an EGT gauge, because a small deflection of the mixture wafers can cause a rapid leaning of the fuel supply which will allow the engine to save fuel at the expense of more expensive burnt metal.

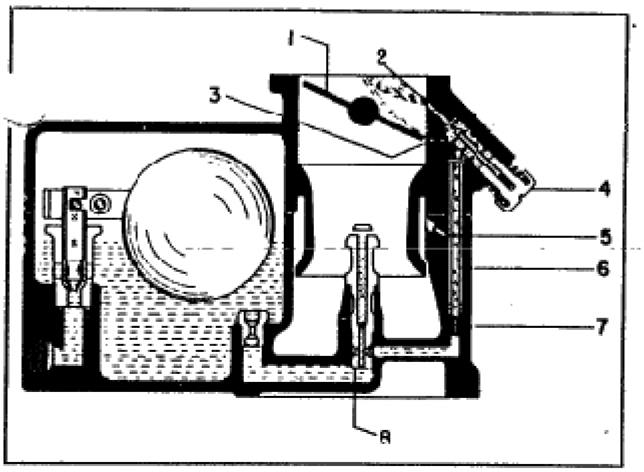

FIGURE 3--SCHEMATIC DIAGRAM OF IDLE SYSTEM

As the throttle is opened, the Idle circuit becomes less effective, so often a Mid-range circuit is activated to deliver fuel until the Main jet becomes active. The Mid range circuit generally consists of another hole, or a series of holes in the carburetor wall slightly upstream from the idle orifice.   These work similar to the Idle circuit, where the rushing air crates a low pressure

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that feeds more fuel into the air stream as the throttle is advanced (figure 3, Item #3). During rapid throttle advancement these Idle and Mid range fuel sources can be inadequate, so they are sometimes supplemented by an Accelerator system, consisting of a small well (figure3 item #6), or a reserve depression where fuel is more easily siphoned during power increases, or some manufacturers use an accelerator pump that physically sprays fuel into the carburetor air stream. (The Stromberg uses an accelerator 'well' system, which is more fuel efficient by being stingy on acceleration fuel, especially on cool mornings immediately after start. Carburetor air will assist in these situations.)

How is the Stromberg different?

Other carburetors use a small hand operated valve in series[1] with the main float and inlet needle valve. When the pilot moves the mixture knob in the cockpit, the valve closes a fuel metering orifice, restricting the fuel available to mix with air in the fuel air mixture in ALL of the above fuel circuits.   Closing the metering orifice completely results in a fuel starvation at the carburetor jets, resulting in engine shutdown, or cut-off due to a lack of fuel.

The Stromberg mixture system has no manual metering orifice in the fuel inlet system; Instead, the Strmberg mixture operates by exerting a vacuum, or less than atmospheric pressure on to the fuel in the float chamber. This is done by diverting low pressure air from behind the carburetor venturi through a wafer system, and into the fuel float bowl figure 4.

I can do no better than copying the Stromberg explanation of this system which reads as follows:

Manual Mixture Control System. (See figure 4.)

(Not incorporated in the NA-S2, NA-S3 and NA-S3B models –*those equipped with cover plates, ed.*)

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[1] “Series” in this instance means that the fuel must pass each restriction one at a time, as opposed to a parallel route, where fuel might feed from two different locations.

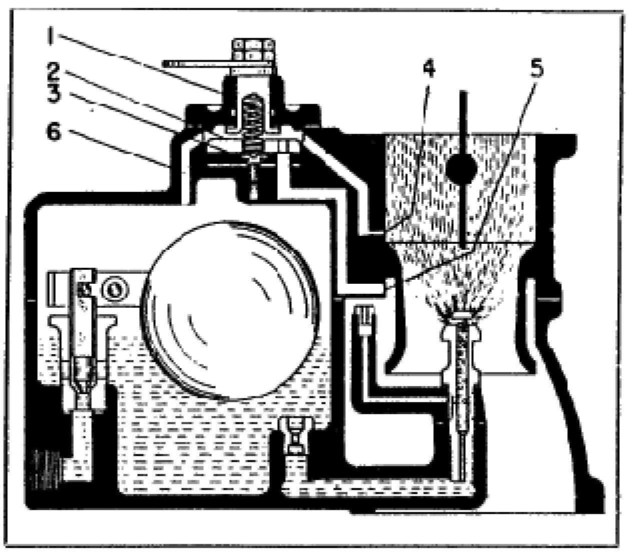

FIGURE 4 –SCHEMATIC DIAGRAM OF MANUAL MIXTURE CONTROL SYSTEM

The manual mixture control system of the back suction type, consists of a manually operated valve (1) having a stationery lower plate (3) and a movable upper plate (2); a

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(a) suction channel (4) and vent channels (5 and 6). When the manual mixture control lever is moved, the upper plate is rotated varying the size of the orifice through the valve.
(b) Briefly, the function of the manual mixture control system is to vary and regulate the pressure applied on the fuel in the float chamber, leaning or enriching the mixture as required.
(c) When the manual mixture control is in the “FULL RICH” position, the large holes in the upper and lower plates are alined so that the fuel in the float chamber is subjected to the full pressure behind the venturi tube (approximately atmospheric), through vent channels (5 and 6.)
(d) Then, as the manual mixture control is moved toward the “LEAN” position, the large hole starts to close and a series of progressively smaller holes in the upper (movable) plate start to open over the hole in the lower plate. This action restricts the air flow through vent channels (5 and 6) to the float chamber. This subjects the fuel in the float chamber to a suction through channels (4 and 6) reducing the *air* pressure forcing the fuel through the *Main* metering jet, resulting in a leaner mixture.
(e) The farther the manual mixture control is moved toward the “LEAN” position, the leaner the mixture becomes *due to less air pressure on the fuel in the float chamber*.

ED note: The ‘automatic leaning’ feature inherent to the carburetor is due to the reduced ambient pressure changes with altitude being transmitted to the fuel chamber as altitude increases resulting in an appropriate reduction of fuel throughout most of the common operating altitudes. This feature effectively eliminates any need for” manual leaning” of the Stromberg carburetor as described above, except in extreme situations, and very high altitudes.

Stromberg Mixture control Operation and Faults.
As noted previously, the Stromberg mixture control has no idle cut-off, and it is very sensitive to movement of the mixture wafers in the mixture chamber. For operations at less than 7-8000 feet, the Stromberg mixture is best left full rich because the inherent design of the carburetor leans the mixture “automatically” with little pilot input. Because of this “auto” feature, the manual mixture is rarely needed until cruising above 10,000 feet.

Many of these mixture wafers have been removed, or the mixture arm wired to full rich to prevent operational errors by un-informed pilots. The back suction mixture control is only effective above about 1600 RPM. If a pilot attempts to stop the engine using this control, the engine will simply continue to idle until either the ignition or fuel valve is turned OFF.

HOWEVER, if the mixture is left in the full lean position, it will usually not become apparent until the next high power run-up, or until the initial takeoff roll, when the engine will lean out and bang, pop, or backfire, at about 1800 RPM. This is because the carburetor then creates an over-lean fuel condition, preventing the engine from accelerating smoothly. After the second or third trip to the hangar with such (pilot induced), symptoms, many operators chose to disable the mixture, or to wire the Stromberg mixture controls to the full “rich” position.
instructions to flight school operators on methods that might be used to disable the mixture control systems so as to prevent ‘student error’ and damage to engines from improper mixture use.

Summary tidbits

The Stromberg carburetor, NAS 3-… , is a very reliable and simple unit used on many vintage engines. The size of the fuel jets and venturi size varies, based upon the engine installation, so it is important to ascertain which dash number carburetor is installed, and to confirm that the carburetor dash number is correct for your engine type, horsepower, and application.

Your mechanic or carburetor shop should have all of the proper information available to select the materials, parts and process available to you for your installation and overhaul. If they do not have access to all the manuals and manufacturer data- go elsewhere for service. A Stromberg for an A-65 will physically fit on an 85 or 90, (and vice versa), but it will not perform properly because the jets and other settings internally are DIFFERENT.

Stromberg needle valves

When the Stromberg carb first appeared in the 1930s, they had stainless steel needles. A service bulletin in 1943 suggested the change to the neoprene tipped stainless needles for better sealing, and to prevent seepage. The seats were also changed with the neoprene needle install. Then in the early1960's, there was another Service Bulletin that suggested the change to the Delrin needle because the neoprene unit was age limited, and had begun to wear, or take a 'set' in service.

The stainless steel needles are still available and remain an acceptable and legal installation. It is an old, tried, and true part. I have used the steel unit to replace the neoprene tips because it is inert and long lived. The steel needle and brass seat do have a tendency to seep when parked, if installed right out of the box, but that can be fixed with some lapping into the seat, or averted by turning off the fuel at the tank valve. Obviously the neoprene tip was engineered to prevent this seepage problem.

Most Strombergs have the steel/brass setup which isn't affected by any kind of fuel. Occasionally it is necessary to rap on the carb to seal it up when the engine is stopped and the fuel is on (I.E. just before startup). When the engine is running the vibration does the same job.

The manufacturer now recommends the Delrin needle. Delrin is a plastic which wears over time and has some poor reactions alleged with alcohol in some auto fuels that should not be introduced, but often are. The biggest problem is that the installation of Delrin requires the shop to modify the float by soldering on weights to offset the much lighter weight of the Delrin needle. This modification takes time and is not easily reversed if you later change your mind to use the steel needle. There is a service bulletin (ACSB-84) that discusses the change from neoprene tipped stainless steel needles to the Delrin needles. A copy of the SB is in the Bendix-Stromberg Overhaul manuals section and the Delrin needle (pn 2523047) is available from CAS. Delrin has similar sealing advantages to the neoprene, but these needles are produced by the current manufacturer, whereas the Stainless steel units are typically Old stock, surplus, or bogus parts produced to replicate the old units. Obviously there is no profit incentive for the current manufacturer to recommend old stock parts or surplus.

Because this problem is more prevalent in a multiple operator training environment, Stromberg developed and sold several models without the mixture components.   They also issued

The seats need to be matched to the type of needle. The overhaul shop or mechanic making inspection and modifications will/should check that.

Cost of the steel/brass kit for valve replacement is about $130. The Delrin kit is similarly priced. My vote is for the old stainless steel with some lapping compound, then the type of fuel is never a question, and wear is not going to occur until two generations down the road.

Auto Gas
We assume that you have installed one of the auto gas STC's before using that fuel in the airplane. If so, then the mechanic making the modification and certifications was required to insure that all of the rubber (neoprene & Delrin), and other components NOT compatible with auto fuel were removed from the system as this is one operating limit to the STC installations. Leaving the neoprene tip in place can be very dangerous because it can swell and even come lose from the needle valve, causing the needle valve to stick closed, or even to free flow fuel. Either condition can cause an unscheduled landing- Thus the reason for the operating limitation for auto fuel requiring the removal of such components.   Use of the Neoprene tip is therefore a very dangerous proposition if you plan to use, or are fueled with anything other than aviation fuel. NOTE: Auto fuel left for several months without operating the aircraft tends to varnish, gum, and cake in the system and may swell O rings or clog some small ports in the Carburetor over time.

Conclusion
The Stromberg Carb is a great unit with outstanding efficiency and a very good service history so long as you do not need an idle cutoff feature, and you understand its operation and leaning limitations.

Sources for Stromberg parts or overhaul manuals
The Luscombe Endowment or Classic Aero Support
(your hosts to this information at www.luscombe.org)

480-650-0883   or Email dlosey@Luscombesilvaire.info